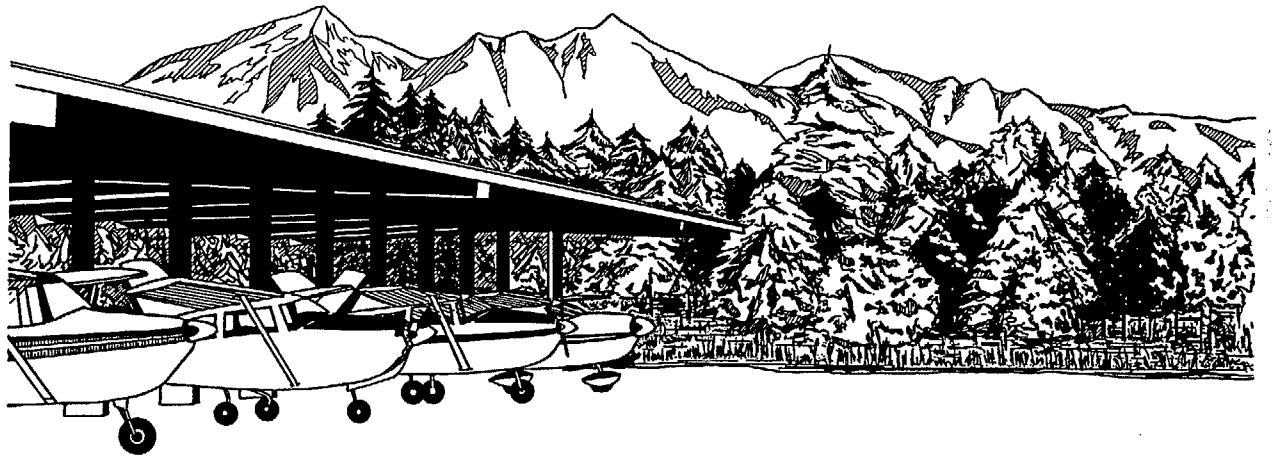
Chapter Four
DEMAND/CAPACITY AND FACILITY REQUIREMENTS



Chapter Four
DEMAND/CAPACITY AND FACILITY REQUIREMENTS

Flagstaff Pulliam Airport

In the previous chapter, forecasts of aviation demand were presented for Flagstaff Pulliam Airport through the year 2010. These forecasts included aircraft operations, passengers, based aircraft, peaking characteristics, and aircraft fleet mix. In order to properly plan for the airport's future, it is necessary to translate forecast aviation demand into the types of facilities that will adequately service these needs. These facilities are categorized as both **airside** (i.e., runways, taxiways, navigational aids, lighting) and **landside** (i.e., terminal building, automobile parking, apron and hangars, and fueling) requirements.

In this chapter, the existing components of the airport and their individual capacities are identified and described. These capacities are then compared to forecast demand levels to determine if deficiencies in airport facilities exist or are expected to materialize. Once deficiencies in airport facilities are identified, a more specific determination of the sizing and timing of any new facilities can be made.

In planning for future facilities at Flagstaff Pulliam Airport several factors must be considered. Flexibility of plans, stages of development, operational capabilities, potential impacts on socioeconomic and environmental elements, and funding sources are the primary areas of concern regarding future airport expansion or development programs. Some of the future facilities will be eligible for federal grant participation. It is important to examine carefully both the needs for these facilities and their eligibility for

federal grants, since the feasibility of the airport itself is greatly influenced by the proper balance of funding programs. An analysis of the overall facility needs at Flagstaff Pulliam Airport is described under the airside and landside sections following the demand/ capacity analysis.

CAPACITY/DELAY ANALYSIS

The capacity/delay analysis identifies components of the airfield system that may require expansion to accommodate projected aviation demands. In order to accomplish this, it is necessary to determine existing capacity levels or capabilities of various airfield components. These determinations are then compared to projected demand levels to estimate when additional capacity might be required to relieve congestion and reduce delays. Subsequently, the approximate timing for additional facilities can be established for the 20-year planning period.

AIRFIELD CAPACITY

A demand/capacity analysis of the airfield measures the capacity of the runway and taxiway system to accommodate the activity levels anticipated. A demand/capacity analyses was performed for the existing runway configuration at Flagstaff Pulliam Airport and was based on the methodology provided in FAA Advisory Circular 150/5060-5, **Airport Capacity and Delay.** This methodology utilizes a combination of variables which provides a more realistic picture of both the ground and air constraints being experienced at U.S. airports than was provided by previous methodologies. The analysis measures the capacity of the airfield in three primary areas: hourly capacity of the runway; annual service volume; and aircraft delay during peak hour conditions.

Hourly Capacity is a basic measure of capacity that can be related to peak hour activity. Hourly capacity of runways is defined as the maximum number of aircraft operations that can take place in one hour. This measure will be influenced by exit taxiway locations, weather conditions, and the level of touch-and-go activity.

Annual Service Volume is a measure of the airport's operational capacity that may be used as a reference in planning the runway system. In general, as annual aircraft operations increase and approach annual service volume, the average delay to aircraft throughout the year increases. In most cases, aircraft delays up to three minutes are considered guideposts that indicate to airport management an airfield capacity increase should be in the planning stage. Aircraft delays in excess of three minutes are considered significant and an increase in the airfield's capacity is required. As the number of annual operations exceeds annual service volume, moderate to severe congestion may occur.

Hourly runway capacity, annual service volume, and aircraft delay are all interrelated and highly dependent on a number of capacity factors. The specific factors considered in this capacity analysis included:

- **Airport Layout** --- The configuration of the runway, taxiways and terminal area.
- **Meteorological Conditions** --- Weather conditions as they affect runway utilization and visibility.
- **Aircraft Mix** --- The percent utilization of the airfield by each aircraft type.

- **Runway Use** --- The percentage of time in which each runway is in use.

- **Percent Arrivals** --- The percent of total arrivals in relation to departures during peak hours.

- **Percent Touch-and-Go** --- The percent of total aircraft operations that are touch-and-go training operations.

- **Exit Taxiway Locations** --- The locations of exit taxiways for landing aircraft.

Airfield Layout

The airport layout refers to the location and orientation of runways, taxiways and the terminal area. The existing layout of Flagstaff Pulliam Airport was depicted in Chapter Two. The airport presently consists of a single runway, Runway 03-21, with the a full length parallel taxiway, seven exit taxiways and terminal area located entirely to the west of the runway. The Terminal Building is located approximately 1,800 feet north of the approach end of Runway 03.

The FAA has recently published an entirely new Airport Design Standards guide, Advisory Circular, **AC/150-5300-13**, which consolidated the previous standards for Utility and Transport airports into more comprehensive and manageable guidelines for airport design. The standards for airport design are related to the characteristics of the aircraft operating at the airport and are determined by two criteria: **Aircraft Approach Category** and **Airplane Design Group**. The aircraft approach category for aircraft operating at Flagstaff Pulliam Airport is **Category C**, aircraft with approach speeds up to but less than, 140 knots (nautical miles per hour). The airport should be designed to accommodate aircraft in Airplane Design Group (ADG) III, (aircraft with wingspans up to but not including, 118 feet).

Meteorology

Weather conditions can affect runway utilization due to changes in cloud ceiling and visibility. Limited ceilings and visibility affect the permissible spacing between aircraft, thus constraining the capabilities of the airfield system to accept operations.

The **Airfield Capacity and Delay** advisory circular (150/5060-5) recognized three categories of ceiling and visibility minimums. **Visual Flight Rules (VFR)** are in effect whenever the cloud ceiling is at least 1,000 feet above ground level and the visibility is at least 3 statute miles. **Instrument Flight Rules (IFR)** are in effect whenever the reported cloud ceiling is at least 500 feet but less than 1,000 feet and/or visibility is at least one statute mile but less than three statute miles. **Poor Visibility and Ceiling (PVC)** conditions exist whenever the cloud ceiling is less than 500 feet and/or visibility is less than one statute mile.

At Flagstaff Pulliam Airport , VFR conditions occur 95.5 percent of the time. IFR conditions are in effect 4.5 percent of the time. The airport is below minimums (when the ceiling is less than 600 feet and/or the visibility is less than one mile) less than two percent of the time according to the airport's climatological data. An improvement to less than 1 percent of the time might be accomplished with a precision instrument landing system (ILS) installed.

Wind conditions are also of prime importance in determining runway use and orientation. The existing runway orientation provides 99.6 percent crosswind coverage for winds with

velocities of 15 miles per hour. This weather data was derived from records obtained from the National Oceanic and Atmospheric Administration (NOAA) and are based on weather observations taken between 1962-1978. The existing wind pattern do not require the construction of a crosswind runway

Runway Use

Runway use is expressed in terms of the number, location, and orientation of active runways. It involves directions and the kinds of operations using each runway. A non-precision instrument approach is available to Runway 21 and a circling approach is available to Runway 03. Approximately 75 percent of the airport's operations are conducted on Runway 21. Runway 21 is designated the calm wind runway.

Aircraft Mix

The airside capacity methodology identifies four classes into which aircraft are categorized. Classes A and B include small propeller aircraft and business jets weighing 12,500 pounds or less that are typical of general aviation. Classes C and D consist of large jet and propeller aircraft generally associated with airline and military use. **Exhibit 4A** provides an illustration of aircraft in each of these classes.

Based upon the forecasts of demand presented in the previous chapter, the aircraft operational mix used in calculating the capacity of Flagstaff Pulliam Airport is presented in **Table 4A**.

Table 4A
Aircraft Operational Mix
Flagstaff Pulliam Airport

	AIRCRAFT CLASSIFICATION			
YEAR	A	B	C	D
Existing	71%	18%	11%	0%
1995	70%	18%	11%	0%
2000	68%	19%	12%	0%
2010	59%	26%	15%	0%

Typical Aircraft by Classification

Class A: Small, engine, gross weight 12,500 pounds or less

Examples:

Cessna 207 Cessna 172/182
Cessna 210 Bell 206

Class B: Small, twin engine, gross weight 12,500 pounds or less

Examples:

Dash-6 Navajo
Cessna 402 King Aire
Baron

Class C: Large aircraft, gross weight 12,500 to 300,000 pounds

Examples:

Dash-8 Jetstream 31
DC-3 Convair
Boeing 737

Class D: Large aircraft, gross weight more than 300,000 pounds

Examples:

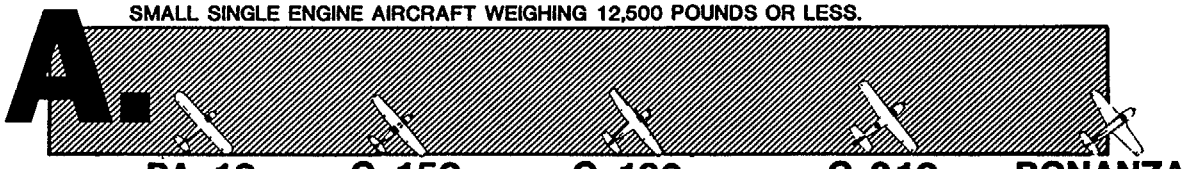
Lockheed
L-1011 Douglas DC-8-60/70
Boeing 747 Airbus A-300/A-310

89MP21-4A-4/1/90

AIRCRAFT CLASSIFICATIONS

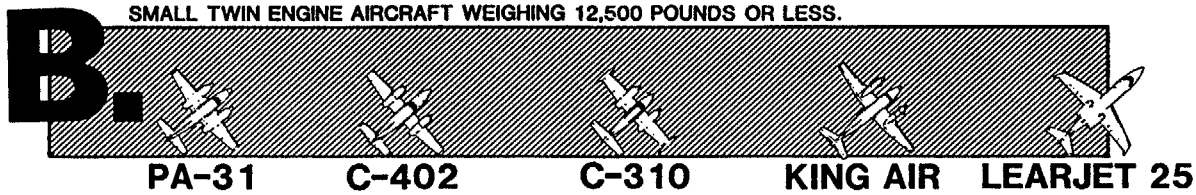
AIRCRAFT CLASSIFICATION	REPRESENTATIVE TYPES OF AIRCRAFT DESCRIPTION

A. SMALL SINGLE ENGINE AIRCRAFT WEIGHING 12,500 POUNDS OR LESS.



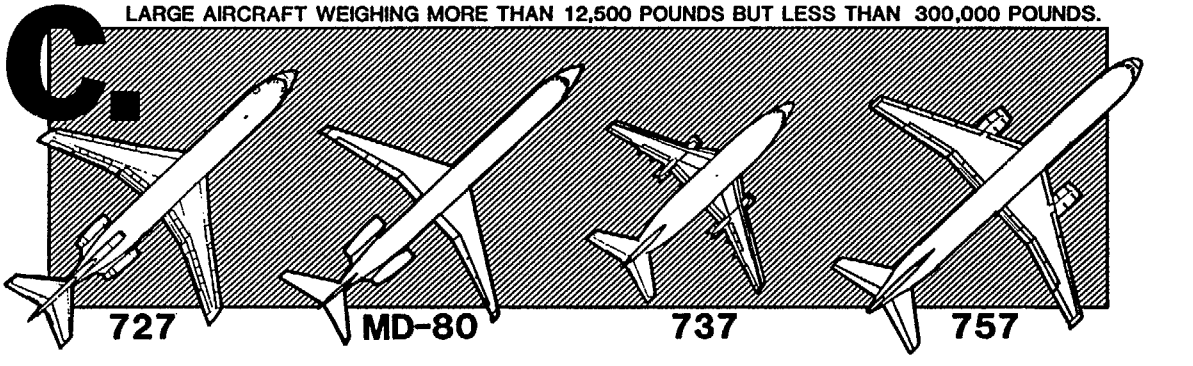
PA-18 C-150 C-180 C-210 BONANZA

B. SMALL TWIN ENGINE AIRCRAFT WEIGHING 12,500 POUNDS OR LESS.



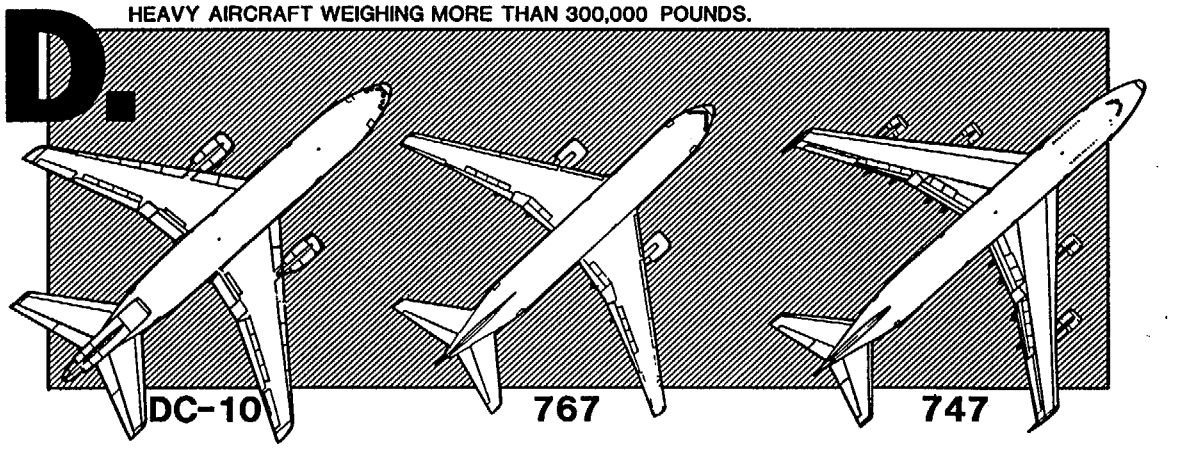
PA-31 C-402 C-310 KING AIR LEARJET 25

C. LARGE AIRCRAFT WEIGHING MORE THAN 12,500 POUNDS BUT LESS THAN 300,000 POUNDS.



727 MD-80 737 757

D. HEAVY AIRCRAFT WEIGHING MORE THAN 300,000 POUNDS.



DC-10 767 747

1. WEIGHTS REFER TO MAXIMUM CERTIFIED TAKE OFF WEIGHT.
2. HEAVY AIRCRAFT ARE CAPABLE OF TAKE OFF WEIGHTS OF 300,000 POUNDS OR MORE WHETHER OR NOT THEY OPERATE AT THIS WEIGHT.

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Exhibit 4A
AIRCRAFT CLASSIFICATIONS

Percent Arrivals

The percent of arrivals also has an influence on the capacity of runways. In most cases, the higher the percentage of arrivals during the peak periods, the lower the capacity.

Except in very unique circumstances, the arrival-departure split is typically considered to be 50-50. At Flagstaff Pulliam Airport, it was assumed that arrivals will generally equal departures during peak periods.

Touch-and-Go Operations

A touch-and-go refers to an aircraft which lands then makes an immediate take-off without coming to a full stop or exiting the runway. These operations are normally associated with training and are included in local operations figures reported by the air traffic control tower.

The majority of the based aircraft at the airport operate in a typical general aviation manner where most local training operations involve touch-and-go activity. The existing touch-and-go level is approximately 35 percent and projected to remain at that level throughout the planning period.

Exit Taxiways

The most notable characteristics considered in the airside capacity model, outside of the runway configuration, are the number and types of taxiways available to exit the runway. The location of exit taxiways affects the occupancy time of an aircraft on the runway. The longer a plane remains on the runway, the lower the capacity.

Seven exit taxiways are available on the runway at Flagstaff Pulliam Airport. The capacity analysis, however, gives credit to only those exits located within a specified range of the runway threshold. For the Flagstaff Pulliam Airport, exits qualify if located within a range of 2,000 to 4,000 feet (3,500 feet to 6,500 feet during IFR conditions) from the runway threshold. The number of exits satisfying this criteria for each approach end of Runway 03-21 illustrated in Table 4B.

Table 4B
Exit Taxiways
Flagstaff Pulliam Airport

	VFR			IFR		
Runway	Mix Index	Exit Criteria	# of Exit Taxiways	Mix Index	Exit Criteria	# of Exit Taxiways
Runway 03	11-15	2000-4000	2	80	3500-6500	2
Runway 21	11-15	2000-4000	1	80	3500-6500	3

CAPACITY ANALYSIS

Based upon the airside capacity methodology, the preceding information was used to determine the airfield capacity at Flagstaff Pulliam Airport. Three separate results were obtained from the analysis.

- Hourly Capacity of Runway
- Annual Service Volume
- Annual Aircraft Delay

From these results it is possible to determine the adequacy of the current airfield to accommodate existing and future demand and to determine the range of aircraft delay associated with each demand level throughout the planning period.

Hourly Runway Capacity

The first step of the analysis involved the computation of an hourly runway capacity for each runway end. Wind direction and the percentage of IFR weather are then used to determine the weighted hourly capacity of the airfield. Weighted hourly capacity represents an adjustment of hourly capacity to account for the percentage the runway is used during IFR and VFR conditions. The weighted hourly capacity is always equal to or less than the hourly capacity.

Based upon the existing runway system, an existing aircraft mix of 11 percent Class C operations, 35 percent touch-and-go's, and the taxiway exit rating, the existing weighted hourly capacity was determined to be approximately 81 operations per hour. In the future, the percentage of Class C aircraft is expected to increase while the percentage of touch-and-go activity is expected to remain constant. These factors result in a decrease in the weighted hourly capacity to 77 operations per hour for the year 2010.

Annual Service Volume

Once the weighted hourly capacity is known, the annual service volume (ASV) can be determined. ASV is calculated by the following equation.

$$ASV = C \times D \times H$$

C = weighted hourly capacity
D = ratio of average daily demand to average daily demand during the peak month
H = Ratio of average daily demand to average peak hour demand during the peak month.

The ASV for Flagstaff Pulliam Airport for existing conditions (1989) is 276,200 operations. In the future, a heavier aircraft mix will reduce the weighted hourly runway capacity from 81 to 77 operations and there will be a slight decline in the daily and hourly demand factors. The ASV will decrease as a result of anticipated changes in the peaking characteristics for the airport. Consequently, the ASV will be approximately 189,800 operations by the year 2010.

Table 4C summarizes airfield capacity for the Flagstaff Pulliam Airport expressed in terms of the ASV. This table indicates that current annual operation levels are 21 percent of the ASV. Without the implementation of airport improvements, by the year 2005, annual demand will reach 66 percent of annual airfield capacity, and by the year 2010, annual demand is expected to be 84 percent of capacity. The FAA generally recommends consideration of the development of improvements for capacity when annual operations reach 60 percent of ASV. Therefore, planning for an increase in airport capacity should begin in the latter half of the planning period.

The 1984 Flagstaff Pulliam Airport Master Plan recommended the addition of an exit

taxiway in order to increase capacity. With an additional exit taxiway, the ASV can be improved by approximately 8 percent over the existing ASV for the airport. A parallel runway to improve the airport's runway capacity is not warranted during the planning period of this study. **Table 4C** and **Exhibit 4B** illustrate the changes in ASV with no improvements and with an additional exit taxiway.

Exhibit 4B graphically illustrates the relationship of the forecast demand to the ASV for each condition evaluated: the single runway with no improvements, the single runway with the addition of maximum taxiway improvements, and a parallel runway.

Table 4C
Demand/Capacity Analysis
Flagstaff Pulliam Airport

	Forecast Demand						
Year	Annual Operations	Daily Demand	Hourly Demand	Weighted Hourly Cap.	Existing Airport ASV	Average Delay/Aircft (Min)	Total Annual (Hours)
1989	59,339	310	11	79	275,700	>1	124
1995	86,100	305	10	79	244,000	>1	502
2000	110,800	300	10	78	225,200	>1	1,151
2005	136,100	295	9	77	207,100	1	2,087
2010	159,400	290	9	76	189,800	2.2	5,804
					Add. Twy ASV		
1995				83	261,100	>1	430
2000				82	249,000	>1	1,013
2005				80	230,600	>1	1,693
2010				79	215,700	2.0	5,409

Source: AC150/5060-5

Annual Delay

Before an airport reaches capacity, it begins to experience certain levels of delay to aircraft operations. For this reason, even when the annual demand is less than ASV, peaking of aircraft operations can have significant effects on the ability of existing facilities to meet future demands. In the case of the Flagstaff Pulliam Airport, peaking characteristics are a critical consideration.

The unique peaking characteristics and an acceptable level of delay for this airport must be considered in the analysis of facility requirements and the timing of airport improvements.

Delay can be expressed as an average delay time per aircraft operation or can be expressed in terms of total annual delay. The average delay per operation for the Flagstaff Pulliam Airport is estimated to be less than

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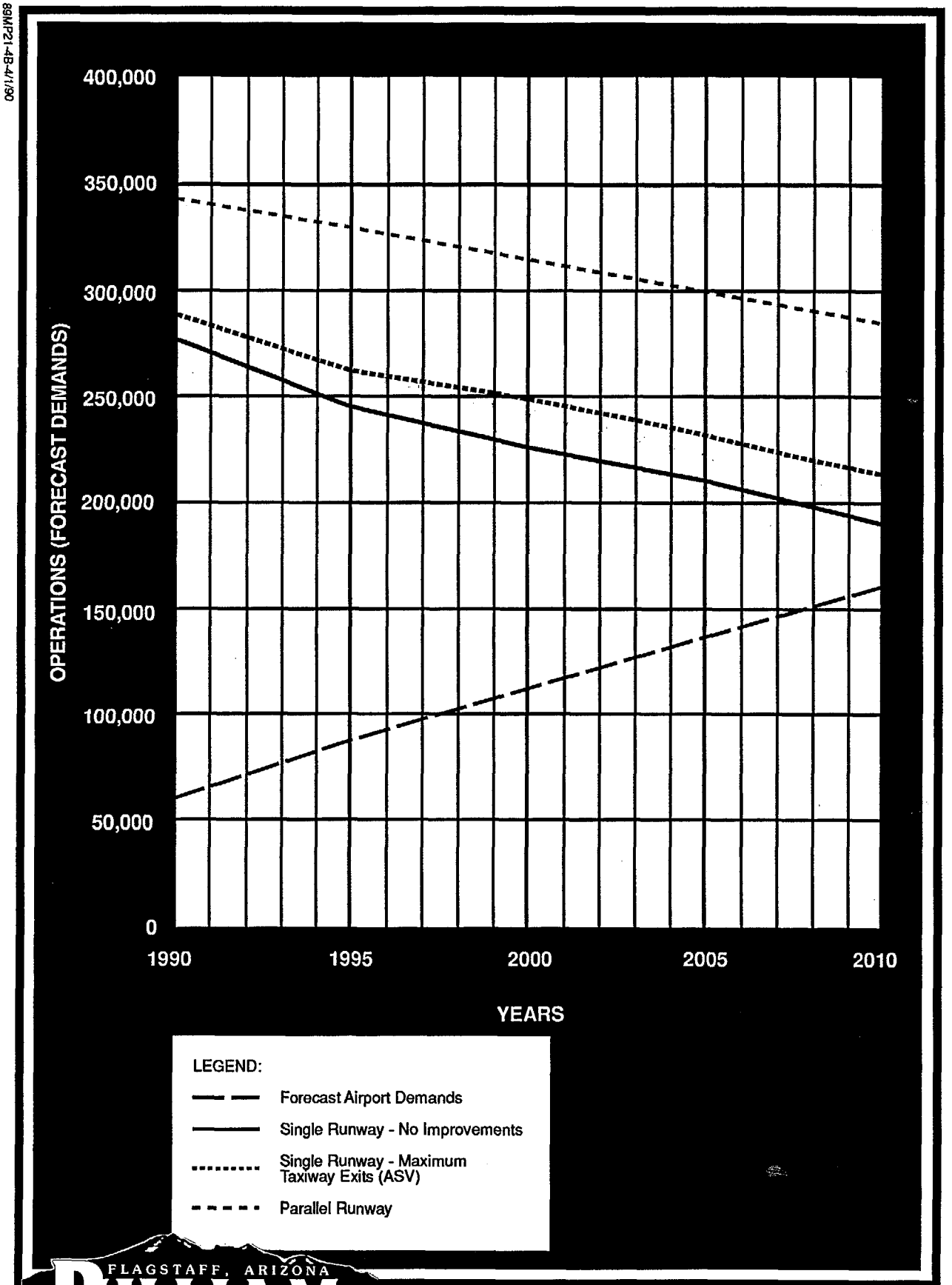

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Exhibit 4B
ANNUAL SERVICE VOLUME ANALYSIS

thirty seconds for the existing condition and is expected to increase to just over two minutes in the year 2010. Since these figures represent average delay over both peak and non-peak periods, it is not likely that the airport will experience very significant delays in the near future. With the addition of airport improvements to increase capacity, significant delays to aircraft will not occur at the airport during the planning period.

Annual delay is currently estimated at 124 hours for the Flagstaff Pulliam Airport. By the year 2010, without changes in facilities, this delay is expected to increase to a total of 4,617 hours. Total annual delay for the airport under existing conditions and with the addition of another exit taxiway is listed in **Table 4C.**

SUMMARY

A review of the results of demand/capacity and delay for the Flagstaff Pulliam Airport indicates that minor airport improvements will enhance the airfield capacity during the planning period. The construction of an additional taxiway would serve to adequately increase capacity in the long-term planning period. However, planning for a parallel runway should commence during the latter stages of the planning period.

FACILITY REQUIREMENTS

AIRSIDE FACILITIES

Airside facilities are those directly related to the arrival and departure of aircraft. These facilities are comprised of the following items:

- Runways
- Taxiways
- Navigational Aids and Lighting

As was previously mentioned under Demand/Capacity analysis, the selection of the appropriate FAA design standards for the development of airfield facilities is based primarily upon the characteristics of the aircraft which are forecast to use the airport. The most important characteristics are the approach speed and the size of the critical design aircraft. The planning for future aircraft use is particularly important because the appropriate design standards must be applied to the separation distance between facilities in order to avoid an extremely costly relocation at a later date.

According to FAA Advisory Circular AC 150/5300-13, **Airport Design**, aircraft are grouped into five categories based upon their certified approach speed. These categories range from Category A for slower single-engine piston aircraft to Category E for supersonic jet aircraft. Most of the based aircraft using Flagstaff Pulliam Airport now fit into Categories A or B (approach speeds less than 121 knots) with a few Category C aircraft (approach speeds less than 141 knots).

The advisory circular also indicates six airplane design groups (ADG) according to the physical size of the aircraft. The airplane's wingspan is the principal characteristic affecting design standards. Airplane design groups range from ADG I for small aircraft with wingspans less than 49 feet to ADG VI for the largest air carrier and cargo aircraft. Aircraft using Flagstaff Pulliam Airport fit into ADG's I, II, and III (aircraft with wingspans less than 118 feet). A **Transport Airport** is an airport designed, constructed, and maintained to serve airplanes in Aircraft Approach Categories C and D.

Another factor affecting airport design is the instrument capability of the airport, i.e. whether visual, nonprecision or precision instrument capability is provided at the airport. The type of instrument procedures authorized at the airport have a direct bearing on the separation standards imposed by the FAA.

As indicated in the forecast section, general aviation operations will increase and the fleet mix is expected to change throughout the planning period at Flagstaff Pulliam Airport. The airport is expected to continue serving small business jet aircraft in addition to the commercial service aircraft. Ultimate planning should be to maintain a **transport** runway designed to accommodate **Aircraft Design Group III, Approach Category C** aircraft, with a **precision instrument capability** to at least one runway and in order to meet the present and future needs. Not all facilities will be required to meet the specific standard for ADG III. In areas where facilities have been designed for ADG I and II aircraft, separation standards are normally reduced. Thus, the facility requirements outlined in this chapter correspond to the design standards described in FAA Advisory Circular 150/5300-13, Airport Design, for the particular airplane design group being served.

The following paragraphs will describe the scope of facilities that would be necessary to accommodate the future level of activity and aircraft projected for Flagstaff Pulliam Airport throughout the planning period.

Existing Airfield Layout

In developing the forecasts for the airport in the previous chapter, the current Approach Category C and ADG III were examined and determined to be adequate for the future demand. However, in comparing the FAA design standards to accommodate the existing approach category and ADG, several deviations were noted between existing separations and FAA design standards for the particular ADG and Approach Category.

Runway 03-21 is served by a full length parallel taxiway that is located 250 feet west of the runway centerline, although the taxiway-runway separation distance standard for this airport is 400 feet. The actual separation required to accommodate the Boeing 737 aircraft (the aircraft selected as the airport's design aircraft) is 309 feet. In either case, the runway-taxiway separation is less than required.

The aircraft parking-runway centerline separation standard for ADG III aircraft is 500 feet (400 feet for the Boeing 737 aircraft). The existing aircraft parking to runway centerline separation is approximately 325-350 feet. The existing aircraft tiedowns should be relocated to conform to the FAA design standard for this airport.

Another potential airport deficiency in meeting prescribed standards is in the location of buildings in relation to the runway. This standard, referred to as the **Building Restriction Line (BRL)**, requires buildings to be located outside of an area on the airport that encompasses the runway protection zones, the runway visibility zone and all areas on the airport with less than 35 foot clearance under the Part 77 imaginary surfaces. If an Instrument Landing System is installed on the airport, as presently planned, the terminal Building and several hangars will be located within the BRL.

Runways

The adequacy of the existing runway system at Flagstaff Pulliam Airport has been analyzed from a number of perspectives, including

runway orientation, airfield capacity, runway length and pavement strength. From this information, requirements for runway improvements were determined for the airport.

- **Runway Orientation**

Airport runways are oriented so that pilots do not have to contend with significant crosswinds. Crosswinds are considered significant for Transport airports when this meteorological condition occurs more than 5 percent of the time, and exceeds 15 miles per hour (13 knots). The transport runway at Flagstaff Pulliam Airport is aligned northeast-southwest and provides 98 percent coverage for 12 mile per hour crosswinds and 99 percent coverage of crosswinds up to 15 miles per hour. The present runway orientation meets the required wind coverage criteria and a crosswind runway is not required.

- **Runway Length**

The determination of runway length requirements are based upon four primary factors: 1) the type of aircraft expected to use the runway; 2) the mean maximum daily temperature of the hottest month; 3) the elevation of the airport and; 4) the effective gradient of the runway. At Flagstaff Pulliam Airport, the mean maximum daily temperature of the hottest month is 81.9 degrees Fahrenheit. The airport elevation is 7,011 feet Mean Sea Level (MSL) and the effective runway gradient is 0.23 percent. Based on an analysis of all aeronautical factors and the type of aircraft expected to operate at the airport, the present runway length should be increased to accommodate almost all aircraft anticipated to operate at Flagstaff Pulliam Airport during the 20-year planning period.

The length of the runway increase is somewhat arbitrary, in that runway length at high elevation airports is not the critical element for some of the aircraft operating at this airport. High temperatures and high elevations affect aircraft engine and airframe performance significantly and, in some cases, some aircraft will be unable to takeoff whatever runway length is available.

Table 4D shows the types of aircraft and the operating assumptions used in determining the required runway length. In making this determination, two factors were introduced into the calculations of required runway length: practical aircraft operating weight and percentage of aircraft accommodated. In evaluating a future runway length, it was assumed that commercial service aircraft requirements should play a prominent role in determining the runway length requirements. In order to satisfy most commercial service aircraft, a runway length of 7,500-8,000 would be most practical. A runway length of 8,300 feet will accommodate most general aviation and commercial air service needs. If at all possible a runway length of 8,300 feet is recommended for Flagstaff Pulliam Airport.

Table 4D
Runway Length Requirements
Flagstaff Pulliam Airport

Aircraft Model/Type	Approval Speed (KTS)	ADG	Maximum Takeoff Weight (lbs)	Practical Aircraft Operating Wgt (lbs)	Required Runway Length (FT)
General Category					
Utility Aircraft [1]	<121	I, II	<12,500	NA	8,300
Large Aircraft	<141	I, II, III	<60,000	NA	7,600-8,800 [2]
Large Aircraft [3]	<141	III	>60,000	NA	7,500
Operating Aircraft					
Swearington Metro	112	I	12,500	12,000	5,200
De Havilland Dash 8	90	III	29,600	29,600	6,750
Boeing 737/200 [4]	137	III	115,500	90,600	6,985
Boeing 737/300 [5]	137	III	135,000	110,000	6,375
BAE 146/100	113	III	82,250	74,000	5,600
BAE 146/200	117	III	89,500	80,000	7,500
Recommended		**III**	**150,000**		**8,300**

Sources: AC 150/5300-13, Boeing 737-200/300 Airplane Characteristics-Airport Planning; British Aerospace BAE-146, Airport Planning; De Havilland Corporation.

Notes:
1 Small aircraft, 12,500 lbs or less, including those with 10 passenger capacity.
2 75 percent of the large aircraft, 60,000 lbs or less, with 60% (7,600 ft) or 90% (8,800 ft) of their payload.
3 Airplanes in excess of 60,000 lbs gross weight.
4 Aircraft equipped with JT8D-17/17A Engines; adjusted to 82°F temperature.
5 Aircraft equipped with CFM56-3B-2 Engines; adjusted to 82°F temperature.
NA = Not Applicable

- **Runway Strength**

Runway 03-21 has a dual wheel weight bearing capacity of 95,000 pounds and should be upgraded to a weight bearing strength of 150,000 pounds during the planning period. Producing this pavement strength level, 150,000 pounds dual wheel loading, can be accomplished through periodic pavement overlays during the planning period.

Taxiways

Taxiways are planned and developed primarily to facilitate movement between the runway and aircraft parking areas. Most of the existing taxiways will accommodate the forecast peak hour operations for the airport during the planning period. In order to provide an additional measure of capacity, it is recommended that another exit taxiway be constructed during the planning period. In

addition, when the runway is lengthened as recommended, the parallel taxiway should be lengthened to conform to the new runway extension.

Holding aprons are already in-place at both runway ends and may only require an increase in their size to accommodate more aircraft during the planning period. Additional taxiways/taxilanes may also be required in support of hangars and tiedowns constructed during the planning period.

The weight bearing strength of the taxiways should be commensurate with the type of aircraft and bearing loads anticipated to use the pavement surface. All the existing taxiways, except those serving exclusively ADG I and II aircraft, will require additional strengthening. Periodic overlays during the planning period will meet the strength requirements of aircraft forecast to operate at the airport.

Navigational Aids and Lighting

Airport and runway navigational aid requirements are based upon FAA recommendations as depicted in DOT/FAA Handbook 7031.2B, **Airway Planning Standard Number One**, and FAA Advisory Circular 150/5300-2D, **Airport Design Standards - Site Requirements for Terminal Navigational Facilities.**

Navigational aids provide precision or non-precision guidance to a runway(s) or the airport. The basic difference between a precision and nonprecision navigational aid is that the former provides electronic descent, alignment (course), and position guidance, while the nonprecision navigational aid provides only alignment and position information. The necessity of such equipment is usually determined by design standards predicated on safety considerations and operational needs. The type, purpose, and volume of aviation activity expected at the airport are factors in the determination of the airport's eligibility for navigational aids.

The airport sponsor has been attempting to secure an Instrument Landing System (ILS) for the airport for some time. The potential ILS installation has been evaluated by the FAA and determined to be feasible on Runway 21 with the use of an Endfire Glideslope antenna. This antenna would allow a slight offset to a straight-in approach to Runway 21 and avoid the obstacles in the protected airspace for an ILS aligned with the runway centerline. The system has been approved for establishment at the airport and is presently awaiting funding by FAA.

In conjunction with the ILS, an approach lighting system will be installed as well. A medium intensity approach lighting system with runway alignment indicator lights (MALS-R) could provide minimum visibility requirements down to as low as one half mile.

It is recommended that the airport secure a Runway Visual Range Indicator (RVR), an instrument that provides accurate runway visibility readouts that can be remoted to the ATCT. During weather conditions when the prevailing weather is less than VFR, the RVR will provide valuable visibility information to pilots attempting instrument approaches to the airport. Under the current FAA criteria in Airway Planning Standard No. 1, Flagstaff Pulliam Airport qualifies for an RVR.

The treeline east of the present runway creates a variable wind pattern at the runway ends. The existing weather instruments, due to their present location, do not always provide accurate information on the runway wind conditions. It is recommended that wind recording instruments be installed midfield and at the end of Runway 21 in order to alleviate this problem.

Existing lighting on runways, taxiways, and aprons is adequate to provide sufficient safety and security throughout the planning period. When the ILS is installed, the FAA recommends that the medium intensity runway lights (MIRL) should be replaced by high intensity lighting (HIRL). In addition, the installation of a REIL on Runway 03 would improve runway end identification during low visibility conditions.

The recommended airside requirements for the airport during the planning period are illustrated in **Exhibit 4C.**

LANDSIDE FACILITIES

COMMERCIAL SERVICE

The capacity of the existing commercial service terminal area facilities were calculated and compared to the forecast terminal area demand for the airport. The areas analyzed include the passenger terminal building, airline gate positions, terminal apron area, and air cargo facilities. The capacities of each of these terminal components were evaluated in relation to forecast demand to determine the overall adequacies of each component of the terminal area. Deficiencies in capacity were identified to define future needs of the terminal area. The Terminal Building was the subject of a special study that was conducted during the inventory phase of the master plan. This study is included as an appendix to the master plan (Appendix A).

Terminal Building

The existing air carrier passenger terminal building was evaluated based on planning guidelines relating to the major functional elements of the terminal building as presented in FAA AC 150/5360-9, **Planning and Design of Airport Terminal Facilities at Nonhub Locations** and AC 150/5360-13, **Planning and Design Guidelines for Airport Terminal Facilities.** The methodology used in the analysis of the terminal building involved comparing forecast peak hour passenger demands, enplanements and operations with FAA recommendations for sizing terminal functional areas to accommodate specific demand levels. These requirements were then compared with existing terminal building facilities to determine the ability of the existing terminal to meet these requirements.

The evaluation process included the major terminal building areas that are normally affected by peaking characteristics. The commercial service peaking characteristics for enplanements and commercial service operations were used to determine functional area requirements within the Terminal Building. It was assumed that the U.S. National Weather Service, occupying approximately 1,100 SF of space in the existing Terminal, would vacate the terminal for a new location and facility in 1995. **Table 4E** indicates the existing capacity of the major components of the Terminal Building, followed by the anticipated demand for space throughout the planning period.

As indicated in both **Table 4E** and **Exhibit 4D**, there are several areas in the passenger terminal currently deficient and require immediate attention. The size of the following functional areas should be addressed as soon as possible: Departure Lounge, Airline Ticketing, Airline Operations and Baggage preparation, Baggage Claim and Terminal Services.

Table 4E
Passenger Terminal Space Requirements
Flagstaff Pulliam Airport

Terminal Building Element	Existing (1989)	Forecast 1995	2000	2005	2010
Departure Lounge	700	1,400	1,550	2,200	2,700
Public Lobby					
Waiting Area	1,250	1,300	1,500	2,100	2,600
Baggage Claim Lobby	260	700	800	1,000	1,300
Ticket Lobby	240	400	500	600	800
Airline Ticketing, Operations	910	2,000	2,500	3,100	3,900
Ticket Counter (LF)	36	50	75	85	100
Baggage Claim Area	90	100	120	200	300
Baggage Claim Counter (LF)	20	30	40	45	50
Terminal Services	1,450	3,400	5,500	6,700	8,500
Food & Beverage	360	1,300	1,750	2,100	2,600
Rental Car	570	500	550	700	900
Gift Shop	0	200	250	300	400
Vending Machines	90	100	200	200	300
Restrooms	260	300	500	600	700
Security	0	100	150	200	300
Airport Management	0	600	1,000	1,200	1,500
Concessions	0	300	300	400	500
Maintenance and Storage	20	50	400	600	700
Miscellaneous	150	200	400	500	600
Tenants	1,060	1,060	NA	NA	NA
Total Area (SF)	6,800	12,060	12,470	15,800	20,100

SF = Square Feet
LF = Linear Feet

Airline Gate Positions

The apron opposite the departure area has three marked gate positions in an area approximately 10,500 SY in size. The size of each aircraft position on the apron (gate position) is determined by the wingspan of the aircraft and the maneuvering space needed. An analysis of forecast passenger enplanements and the anticipated number of airlines expected to serve the airport indicate that demand for future gate positions will

exceed existing capacity by the year 1995. The apron required in support of the additional gate positions and apron required during the planning period is indicated in **Table 4F.**

It should be pointed out that the existing airline parking positions are located too close to the main runway (approximately 350-400 feet when they should be 500 feet from runway centerline). In planning for future needs and the possible relocation of the Terminal Building, consideration should be given to relocating airline parking positions according to current FAA standards.

Table 4F
Airline Gate and Apron Demand
Flagstaff Pulliam Airport

Descriptor	Existing (1989)	Forecast 1995	2000	2005	2010
Passenger Enplanements	51,900	69,500	88,700	113,300	144,500
Gate Positions					
Regional Airline	2	2	3	3	3
Commuter Airline	1	2	2	2	3
Total Apron (SY)	12,400	6,900	8,900	10,000	12,900

Source: AC 150/5360-13, Figure 5-1, 5-2
Note: Apron size based upon taxi-in, taxi-out criteria.

Automobile Parking

Automobile parking requirements have been determined for the passenger terminal building and includes taxi or van parking, public parking, employee parking, and rental car spaces. These determinations were based on an evaluation of existing airport and user needs as well as a comparison with industry standards. At the existing location, the auto parking area also serves the general aviation user at the airport, however, general aviation parking requirements will be treated separately in a later section of this chapter.

The requirements for public vehicle parking are determined by the forecast enplaned passengers. Auto parking positions are calculated by using a planning average of 2,000 parking spaces for 1 million enplaned passengers. This average is based on a sample taken at non-hub airports nationwide. Applying a planning standard of 350 square feet per parking space determines the total parking area. **Table 4G** reflects automobile parking needs for the airport's commercial service operations throughout the planning period.

Air Cargo

Air cargo at Flagstaff Pulliam Airport is handled by both the airlines (Skywest and

America West Airlines) and independent cargo carriers (Federal Express, United Parcel Service, etc). As indicated in the forecast chapter, the amount of air cargo handled by the passenger carrying airlines has decreased since airline deregulation. The advent of overnight express package delivery service by private cargo carriers as well as the U.S. Postal Service will significantly impact the growth potential of airline cargo. America West Airlines has cargo space available in the building adjacent to the Passenger Terminal while Skywest moves its cargo daily and requires little storage on the airport.

The overnight express delivery package carriers operate twin engine aircraft and transfer cargo from the aircraft to the truck, requiring only ramp space. Federal Express has a storage and handling facility on the airport while United Parcel Service's storage and handling facilities are located in Flagstaff. Neither carrier has indicated a necessity for additional apron on hangar space at the airport.

As the cargo volume for Flagstaff grows, larger aircraft can be expected to begin operating at the airport. In addition, one or more overnight carriers could choose the airport for their regional operations center in the future. If this should become the case, sufficient apron for a jet aircraft in the Boeing 737 class, would be required.

Future airport planning for cargo handling facilities normally includes space to handle and store cargo next to the apron. Both overnight carriers do not feel it is a requirement that a terminal storage/handling facility be located adjacent to the apron. Other locations on the airport or in the industrial park would meet the needs of the overnight carriers as well.

For planning purposes, it is recommended that the future airport development program include a potential cargo storage and handling area as well as apron space to accommodate the expected growth in this commercial area.

Table 4G
Terminal Building Parking Requirements
Flagstaff Pulliam Airport

Descriptor	Existing (1989)	Forecast 1995	2000	2005	2010
Peak Hour Passengers	54	80	106	136	176
Short Term Parking	135	173	219	262	306
Rental Car	45	60	80	90	100
Employee	18	40	50	60	70
Public	67	68	84	107	131
Other (Taxi, Van, etc.)	5	5	5	5	5
Long Term Parking	56	37	46	58	71
Total Parking Spaces	191	210	265	320	377
Total Parking Area (SY)	7,400	8,200	10,600	12,400	14,670

Source: AC 150/5360-13, AC 150/5360-9

GENERAL AVIATION AREA

This evaluation determines the capacity of the existing general aviation facilities and their adequacy and ability to meet the forecast demand for general aviation facility space through the planning period. This analysis considers the following types of facilities:

- Hangars and Hangar Apron
- Local and Itinerant Apron
- General Aviation Terminal Building
- Vehicle Parking
- Fuel Storage

Hangars and Hangar Apron Area

The space required for hangar facilities is dependent upon the number and type of aircraft expected to be based at the airport. Based upon an analysis of existing general aviation facilities and the current demands expressed by tenants at Flagstaff Pulliam Airport, hangar needs have been calculated.

Approximately 70 percent of the based aircraft are hangared, occupying 96 percent of the available aircraft hangar positions. However, all the hangar space is presently leased and there are currently no hangar vacancies at the airport. Due to the potential for aircraft damage during storms, it is anticipated that approximately 80 percent of the based aircraft desire hangar facilities.

T-hangars, both executive and standard size, and shade hangars will probably accommodate most of the hangar demand during the planning period. Conventional hangar space is also planned in support of the forecast corporate aircraft hangar potential. **Table 4H** depicts the hangar demand throughout the planning period.

Hangar space requirements were calculated based upon a planning standard of 1,500 square feet SF for single engine aircraft, 2,000 SF for helicopters and twin engine piston aircraft, 2,400 SF for turbine powered aircraft. Approximately 20 percent of the hangar storage area is allocated to maintenance service area. An allowance for adequate apron in support of the hangars is calculated by providing at least twice as much additional apron as the overall hangar space requirements.

Table 4H
Hangars and Hangar Apron Areas
Flagstaff Pulliam Airport

Descriptor	Existing (1989)	Forecast 1995	2000	2005	2010
Based Aircraft	107	120	133	146	162
Single Engine	95	101	108	110	116
Twin Engine	4	10	13	15	16
Turboprop	4	4	5	9	11
Turbojet	1	2	3	4	5
Helicopter	1	2	2	2	2
Other	2	2	2	2	2
Number of Aircraft Hangared	72	96	106	117	130
Conventional Hangars	5	6	6	7	8
Conventional Hangar Spaces	11	14	16	18	19
Shade/T-Hangar Spaces	69	82	90	99	111
Conventional Hangar Area (SF)	29,986	34,100	39,800	49,400	56,200
Aircraft Storage	23,286	28,400	33,200	41,200	46,800
Aircraft Maintenance	6,700	5,700	6,600	8,200	9,400
Shade/T-Hangar Area (SF)	79,550	128,300	140,700	154,100	171,900
Total Hangar Apron (SY)	24,341	36,100	40,100	45,200	50,700
Conventional Apron	6,664	7,600	8,800	11,000	12,500
Shade/T-Hangar Apron	17,678	28,500	31,300	34,200	38,200

Aircraft Parking Apron

FAA Advisory Circular 150/5300-13 suggests a methodology by which local and itinerant parking requirements can be determined from a knowledge of busy-day operations. A local aircraft parking apron should be provided for at least the number of local based aircraft that are not in hangars. A planning standard of 2,750 SF per aircraft tiedown was used to determine the local apron requirements throughout the planning period.

At Flagstaff Pulliam Airport, the number of itinerant spaces required was determined to be approximately 35 percent of the busy-day itinerant landing operations or 17.5 percent of the busy-day itinerant operations. FAA planning criterion of 3,240 SF per peak itinerant aircraft was applied to the number of itinerant spaces to determine future itinerant ramp requirements. The results of this analysis are presented in **Table 4L**

Table 4I
Local and Itinerant Parking Apron
Flagstaff Pulliam Airport

Descriptor	Existing (1989)	Forecast 1995	2000	2005	2010
Local Apron Tiedowns	85	24	27	29	32
Local Apron Area (SY)	19,375	7,200	8,100	8,700	9,600
Itinerant Apron Positions	20	42	55	67	78
Itinerant Apron Area (SY)	10,000	14,800	19,200	23,500	27,300
Total General Aviation Apron (SY)	29,375	22,000	27,300	32,200	36,900

Although the existing apron appears to be sufficient to accommodate all of the local and itinerant aircraft parking for the future, there are significant limitations in the current apron. First, most of the aircraft parked in the South Apron are located within the 400 foot restriction to aircraft parking required for Approach Category A & B aircraft for a nonprecision or visual runway. Approximately 50 percent of the aircraft currently parked on the South Apron and 33 percent of the aircraft parked in the North Apron are included within the runway-centerline to aircraft parking standard.

Second, approximately 18,000 SF of pavement in the South Apron is in need of repair. A project is presently underway to improve the South Apron pavement, but even with this completed, compliance with the runway-aircraft parking separation standard will reduce the amount of available apron.

And last, when the airport receives the ILS, the improvement in runway instrumentation will require that a 500 foot runway centerline to aircraft parking separation be established. This could result in the abandonment of some or all of the existing aircraft parking apron. These issues will be addressed in more detail in the next chapter on Alternatives.

General Aviation Terminal Building

At Flagstaff Pulliam Airport, the general aviation pilot and passenger needs are accommodated by the FBO, Alpine Air Service. Space has been set aside in the hangar to meet general aviation terminal needs. This involves not only lobby areas and concessions, but also management offices, flight planning area, classrooms, conference rooms and pilots' lounge. The space demands outlined in **Table 4J** were developed from general aviation terminal building space requirement studies and should be viewed only as general guidelines.

The methodology is based on the forecast number of design hour pilots and passengers which is used in defining specific functional areas. It should be noted that space demands outlined in **Table 4J** are not limited to a separate general aviation terminal building, but may be accommodated in areas leased by Fixed Base Operator(s). The requirements outlined in **Table 4J** are based on demand

levels which should be addressed in the design of new and/or reconstruction of existing facilities to assure that adequate space is provided for future general aviation needs. Not only the amount of space is important, but the allocation of space to each area is just as important. A disproportionate allocation of space will create inefficiencies by creating unusable or underutilized areas.

The terminal building at Flagstaff Pulliam Airport also serves the general aviation user with facilities such as restaurant, lounge, restrooms, etc. In the future, commercial service security requirements will impact the relationship between general aviation and commercial passenger service, which may result in the separation of general aviation terminal facilities from commercial service terminal facilities.

Table 4J
General Aviation Terminal Building Space Requirements
Flagstaff Pulliam Airport

Descriptor (SF)	Existing (1989)[1]	Forecast 1995	2000	2005	2010
Design Hour Pilots/Pax	45	59	70	80	89
Waiting Area/Pilot's					
Lounge		890	1,190	1,200	1,340
Restrooms		90	120	120	130
Concessions		480	650	660	730
Circulation, Mechanical, Etc.		1,460	1,960	1,980	2,200
Total Terminal Space (SF) [1]	10,000	2,900	3,900	4,000	4,400

Notes: [1] At Flagstaff Pulliam Airport, general aviation terminal requirements are met with facilities provided by the FBO.
[2] All Totals rounded to nearest 100 square feet.

Automobile Parking

The requirements for general aviation automobile parking are largely dependent upon the level of aircraft operations in addition to the type of general aviation facilities and activities associated with the airport.

The total number of parking positions and parking area have been determined based on 1.3 spaces per design hour passenger and 350 square feet per parking position. **Table 4K** reflects automobile parking requirements for the general aviation- related operations at the airport. Additional parking facilities may be required if existing automobile parking is not properly situated.

Table 4K
General Aviation Terminal Building Parking Requirements
Flagstaff Pulliam Airport

Descriptor (SF)	Existing (1989)	Forecast 1995	2000	2005	2010
Design Hour Pilots/Pax	45	59	70	80	89
Terminal/FBO Spaces	22	41	49	56	62
General Aviation Spaces	65	90	100	110	122
Total Spaces	87	121	139	159	183
Total Vehicle Area (SY)	3,400	5,100	5,800	6,400	7,200

AIRPORT ACCESS

The main entrance to the airport from U.S. Highway 89A/ Interstate 17 is via a 30 foot wide paved road (Shamrell Boulevard) which branches at the airport beacon into two, 20 foot wide, one-way traffic roads leading into (and out) of the terminal area. Access to the terminal area and facilities from off-airport is satisfactory with the terminal building in its present location. No other alternative road system is required at this time, however, if the terminal building is relocated to a different location on the airport access will need to be re-evaluated.

Access to the Westplex area and airport tenants north of Shamrell Boulevard is provided by Tower Road. This road presently crosses the West Taxiway, a situation that needs to be addressed when general aviation activity in the Westplex Area becomes extensive. The previous Airport Master Plan recommended closure of this access point to the tenants north of the Westplex Area after a new access road is constructed from the planned 4th Street Connector, west of the Westplex Area.

Unpaved perimeter roads provide access to both runway ends from the west side of the runway, however, a perimeter road is required on the east side of the runway to obtain access to the property fence line. Access to the east side of the runway is presently obtained by crossing the runway, a practice that should be avoided if at all possible.

SUPPORT FACILITIES

Various facilities that do not logically fall within classifications of airfield, terminal building or general aviation requirements, have been identified for inclusion in this Master Plan. Facility requirements have been analyzed and identified for these remaining facilities:

- Aircraft Rescue and Fire Fighting Unit
- Fuel Storage
- Utilities

Aircraft Rescue and Fire Fighting (ARFF)

The existing airport ARFF equipment is currently located in a 2,800 SF building in the South Apron area. A new ARFF vehicle, First Responder, will replace the existing vehicle in 1990 and a new ARFF facility is presently under design. The new facility will replace the existing facility and its location will be addressed in the next chapter.

The airport is presently certified for Index A ARFF equipment. However, the Boeing 737 aircraft may become the primary commercial service aircraft near the midpoint of the planning period and require the airport to upgrade to Index B (equipment and materials to support aircraft with wingspans up to 125 feet in length).

Index B requires ARFF equipment with the capability to carry 500 pounds of sodium based dry chemical or Halon 1211 and 1,500 gallons of water. The airport's future development program should include planning for an ARFF upgrade to Index B.

Fuel Storage

Fuel is stored in three locations on the airport, all of the fuel is presently stored in underground tanks. The age of some of the tanks will require a study to determine the feasibility of maintaining the tanks in service or replacing the tanks with above ground storage facilities. All fuel storage areas are leased and operated by the FBO.

Future fuel storage requirements were determined for the airport following an analysis of fuel utilization characteristics. Based upon data obtained from airport administration, average fuel consumed is nearly 5 gallons per operation. This ratio can be expected to increase as the size of the fleet mix increases.

Because of past experiences with spot fuel shortages, fuel storage capacity is advised to at least equal two months supply. This will provide sufficient protection against potential shortages and permit some flexibility to purchase fuel when market prices are lower. At the present time, the FBO can store a 1.8 month's fuel supply.

Table 4L shows an estimate of the total gallons of fuel storage that will be required. The fuel distribution between aviation 100 Octane Low Lead and jet fuel storage will depend upon market demands, but based on the past three years, Jet A demands have been approximately twice the demand for 100 Octane Low Lead.

Table 4L
Fuel Storage Requirements
Flagstaff Pulliam Airport

	Existing (1989)	Forecast 1995	2000	2005	2010
Annual Operations	59,335	86,000	110,500	135,400	158,300
Average Monthly Operations	4,940	7,170	9,210	11,280	13,190
Average Fuel Ratio (gallons/operation)	4.5	5.0	5.5	5.8	6.0
Monthly Fuel Storage Required	22,200	35,900	50,700	65,400	79,100
100 Octane Low Lead	7,800	12,600	17,700	22,900	27,700
Jet A	14,400	23,300	33,000	42,500	51,400
Bi-Monthly Storage Requirement[1]	44,400	71,800	101,400	130,800	158,200

Note: Existing Fuel Storage Capacity is 42,000 gallons.
[1] A shorter delivery schedule could be used to reduce storage capacity required.

As shown in **Table 4L**, at a minimum storage capacity of two months supply, the existing fuel storage capacity is not adequate. However, a shorter delivery schedule could be used to meet the demand throughout the planning period. As most of the existing fuel is stored in underground tanks (some of the older tanks may need to be replaced), this will provide the opportunity for the airport to meet existing and future storage requirements by establishing a new above ground fuel storage area. The abandonment of all underground storage tanks would be uneconomical and inefficient.

The amount of underground storage capacity being removed from the fuel storage inventory and can be contained by the City. By using this method, the financial burden on the airport to replace fuel storage capacity is not nearly as great and the schedule can be altered to meet the availability of funds.

Utilities

The existing airport utilities were evaluated to determine their adequacy to meet future demands of the airport and any projected on-airport development. It was determined that future airport development will require utility expansion in two areas: water and sewer.

The existing water supply was determined to be insufficient to meet fire protection

standards in the previous master plan. The relocation of the Terminal Building or an increase in its size will require that the existing septic system either be upgraded or constructed at another location. A new septic system for the Terminal and the addition of a water storage tank may appear on the surface to be the most economical methods of solving the problem, however, it may be only a temporary solution.

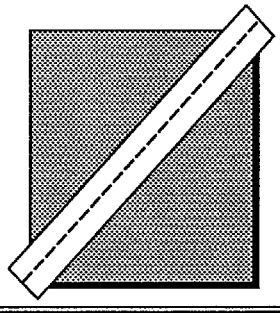
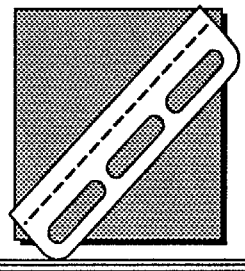
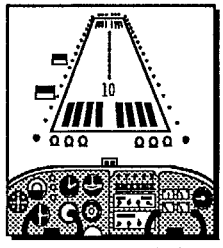
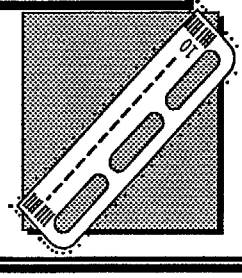
It is anticipated that with the lease of Flagstaff Airpark by the City, commercial growth in the area will require an increase in utility services. The City might be better served by planning for the long term with a more substantial investment in water and sewer systems that support both the Airpark and the airport.

SUMMARY

The intent of this chapter has been to outline facilities required to meet the aviation demands projected for Flagstaff Pulliam Airport. A summary of airside and landside facility requirements is presented in **Exhibits 4C, 4D and 4E.**

This chapter has shown that there is a significant amount of demand for new facilities at Flagstaff Pulliam Airport. The goal of the next chapter in this study will be to provide for additional facilities while attempting to meet the FAA design standards wherever possible without producing a major financial burden for the City.

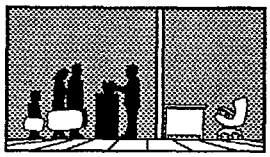
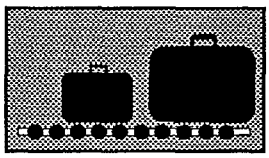
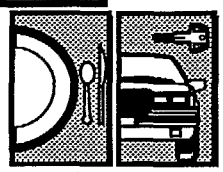
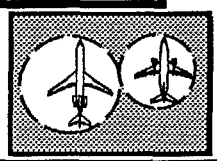
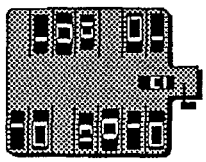
89MP21-4C-4/1/90

	EXISTING	SHORT TERM	ULTIMATE
RUNWAYS 	Runway 03-21 6999' x 150' 30,000 lbs SWL 95,000 lbs DWL	Runway 03-21 8300' x 150' 45,000 lbs SWL 110,000 lbs DWL	Runway 03-21 Same 60,000 lbs SWL 130,000 lbs DWL
TAXIWAYS 	Parallel Taxiway 6999' x 50' West Taxiway 1250' x35' Seven Taxiway Exits	Parallel Taxiway 8300' x 50' West Taxiway Dual 1250' x 35 Same	Same West Taxiway Dual 1830' x 35' Eight Taxiway Exits
NAVIGATIONAL AIDS 	Runway 03-21 ATCT VASI VOR/DME NDB Tetrahedron Wind Socks Rotating Beacon	Runway 03-21 Weather Instruments ASOS Lightning Detector Runway 21 ILS Relocate Wind Cone Runway 03 Wind Cone	Same Runway 21 RVR
LIGHTING and MARKING 	Runway 03-21 MIRL Runway 21 REIL Non-Precision Runway 03 Visual Parallel & Exit Taxiways MITL West Taxiway Delineators	Runway 03-21 HIRL Runway 21 MALS- R Runway 03 REIL West Taxiway MITL	Same Same

FLAGSTAFF, ARIZONA
PULLIAM
AIRPORT

Exhibit 4C
AIRSIDE FACILITY REQUIREMENTS

89MP21-4D-4/1/90

		EXISTING	1995	2000	2010
AIRLINE COUNTER / OFFICE					
	Counter Length (ft.)	36	50	75	100
	Total Area (sq. ft.)	910	2000	2500	3900
BAGGAGE CLAIM					
	Input Area (sq. ft.)	90	100	120	300
	Claim Display (ln. ft.)	20	30	40	50
	Claim Area (sq. ft.)	260	700	800	1300
PUBLIC USE AREA					
	Ticket Lobby (sq. ft.)	240	400	500	800
	Waiting Lobby (sq. ft.)	1250	1300	1500	2600
	Departure Lounge & Security (sq. ft.)	700	1400	1700	2800
VENDORS					
	Food & Beverage (sq. ft.)	360	1300	1750	2600
	Gift Shop (sq. ft.)	0	200	250	400
	Auto Rental (sq. ft.)	570	500	550	900
TERMINAL GATE POSITIONS					
	Regional Airlines	2	2	3	3
	Commuter Airlines	1	2	2	3
	Apron (sq. yd.)	10,500	6900	8900	12,900
AUTO PARKING					
	Curb (ft.)	200	200	200	300
	Public Parking	123	105	130	202
	Employee	18	40	50	70
	Rental Car	45	60	80	100
	Other	5	5	5	5

FLAGSTAFF, ARIZONA
PULLIAM
AIRPORT

Exhibit 4D
PASSENGER TERMINAL FACILITY REQUIREMENTS

89MP21-4E-4/1/90

	EXISTING		1995	2000	2010
HANGARS	Aircraft Positions Total	80	96	106	130
	Conventional Hangar/Positions	5/11	6/14	6/16	8/19
	Executive Hangars	15	15	20	25
	T-Hangars	30	37	38	46
	Shade Hangars	24	30	32	40
APRON TIE-DOWNS	Local Ramp (sq.ft.)	19,375	7200	8100	9600
	Local Ramp Positions	85	24	27	32
	Transient Ramp (sq.yd.)	10,000	17,600	21,500	28,700
	Transient Ramp Positions	20	42	55	78
	Total Apron (sq.yd.)	29,375	22,000	27,300	36,900
FUEL STORAGE	Total Gallons (two months)	42,000	71,800	101,400	158,200
	Jet A (gallons)	22,000	23,300	33,000	51,400
	100 Octane Low Lead (gallons)	20,000	12,600	17,700	27,700
GENERAL AVIATION TERMINAL	Waiting Area/ Pilots Lounge (sq.ft.)	FBO	890	1190	1340
	Restroom (sq.ft.)	FBO	90	120	130
	Concessions (sq.ft.)	FBO	480	650	730
	Circulation, Mechanical (sq.ft.)	FBO	1460	1960	2200
	Total Area (sq.ft.)	10,000	2900	3900	4400
AUTO PARKING	Parking Positions	87	121	139	183
	Terminal	22	41	49	62
	General Aviation	65	90	100	122
	Total Area (sq.yd.)	3390	5100	5800	7200

FLAGSTAFF, ARIZONA
PULLIAM AIRPORT

Exhibit 4E
LANDSIDE FACILITY REQUIREMENTS